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MACROMOLECULAR COMPOUNDS AND POLYMERIC MATERIALS

Thermal and Thermo-Oxidative Destruction of Poly(Ethylene Terephthalate) Modified with Formulation Based on Polyfluorinated Alcohol

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Abstract—Stabilizing effect of 1,1,9-trihydroperfluorononanole-1 immobilized on a montmorillonite support on the stability of poly(ethylene terephthalate) at elevated temperatures was studied. Gas chromatography, IR Fourier spectroscopy, and mass spectrometry were used to examine gaseous products of its thermal and thermo-oxidative destruction. It was found that the initial formation rate of aldehydes and carbon dioxide decreases in the course of thermostating of the fluorine-containing composite polyester material. The method of thermogravimetry demonstrated that modified poly(ethylene terephthalate) has a higher thermal stability.

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One of ways to improve the properties of poly(ethylene terephthalate) (PET) is by obtaining polymeric composites with the use of poly- and perfluorinated compounds [1]. A promising method for introduction of small amounts (10^{-3}–10^{-4} wt %) of poly- and perfluorinated compounds is by using highly dispersed supports (nanosize layered aluminosilicates, calcium carbonate).

It was shown in [2, 3] that industrially manufactured polyfluorinated alcohols $H(CF_2CF_2)_nCH_2OH$ (n = 1–5) sorbed on a montmorillonite support affect the structure and properties of amorphous and amorphous-crystalline heterochain polymers. Combined, the unique nature of polyfluoroalkyl groups and the effect of the shape anisotropy of nanofiller particles provided an increase in the mechanical properties, hydrolytic stability, light and wear resistance of the resulting fluorine-containing composites.

The goal of our study was to obtain a composite material based on poly(ethylene terephthalate) and 1,1,9-trihydroperfluorononanol immobilized on montmorillonite and to examine its thermal and thermo-oxidative stability.

EXPERIMENTAL

As the polymeric matrix served preliminarily ground PET powder with particle size not exceeding 50 μm [Polief OAO, Republic of Bashkortostan, TU (Technical Specification) 2226-008-39989731–2009], content of carboxy groups of 28 mmol kg^{-1}, and characteristic viscosity of 0.79 dL g^{-1}.

The composite of 1,1,9-trihydroperfluorononanole-1 and montmorillonite was a powder in the form of a mixture of three main fractions (50–100 nm, 10 wt %; <1 μm, 80 wt %; <10 μm, 10 wt %), produced by the procedure described in [4]. The content of the polyfluorinated alcohol in the clay was 40.0 wt %.

The composite materials were prepared by mixing PET in a melt with 0.5 wt % organoclay in a double-screw Brabender extruder at a temperature of 260 ± 2°C.